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The Report of the Chief of Ordnance, proper, is a very brief, business-like and well-condensed summary of the operations of the bureau for the fiscal year ending June 30, 1900, covering 42 pages of the volume. The details of the work are exhibited in the remaining four hundred pages, in which are given forty appendices, mainly reports of officers charged by the Bureau with important duties and including the operations of the various arsenals.

Watervliet Arsenal, for example, has turned out during the year 45 ten- and twelve-inch rifles and mortars, and five smaller rapid-fire guns, and has made a large quantity of accessory material. Springfield Armory made about 60,000 army rifles and carbines and attained an output of 400 guns a day. Working eight hours a day, it now turns out about 200. As usual, a large amount of experimental work has been performed. Watertown Arsenal has been engaged upon sea-coast gun-carriages and its great testing-machines—it now has one of 200,000 pounds capacity, in addition to the older machine of 80,000 pounds—have performed a considerable amount of valuable scientific work in addition to that of the routine operation of the Department. Frankford Arsenal has made, during the year, 23,000,000 small-arm cartridges and can now issue about 90,000, per day of eight hours, continuously. Rock Island Arsenal turns out most of the infantry and cavalry equipments of the army. It makes blanket-bags at from \$1 upward, haversacks at from 85 cents, canteens at 32 to 38 cents and tin cups cost but 10 cents to make. Costs have come down and wages gone up with the use of improved machinery. A new small-arms factory is under construction here, to produce 200 to 250 guns a day. Heavy guns for fortifications have been so extensively supplied that the Department is now turning its attention to the smaller rapid-fire guns. A muzzle velocity of 3,000 feet per second is to be attained in the later construction.

Wire-wound guns continue a subject of experiment, but still without complete success. It has come to be a question whether the disappearing gun-carriage for heavy mounts is best practice and whether it has not been too exclusively adopted. The Bureau does not

express a decided opinion on this point. The automatically operating rapid-fire gun is reported upon and recently invented automatic pistols are the subject of investigation, with the result of choice of the Colt construction for army use, if later approved by the Department.

Interesting investigations of the composition of acceptable gun-steels give the valuable deduction that for an elastic limit of 70,000 to 75,000 pounds per square inch, and a tenacity of 100,000, with an elongation 15 to 20 per cent., the compositions should include about one-half of one per cent. carbon, one per cent. manganese, one-fifth to one-tenth per cent. silicon, and well under one-tenth of one per cent. of sulphur or phosphorus. Oil-tempering is not of advantage. Rolling is best performed at a temperature a little way below that of the blue 'critical heat.' One curiously interesting deduction is that the action of smokeless powder, or other high explosive, attaining a given pressure in the barrel of a gun, is less destructive than a similar pressure produced by ordinary static testing. The duration of the pressure is about 0.0004 second only, and time is thought to have an important influence upon results. The normal powder pressure in the army rifle is about 42,000 pounds per square inch. The singularly interesting phenomenon, extensively investigated by the writer many years ago, 'the exaltation of the normal elastic limit by strain,'* finds application here, as in so many other matters of applied science; the practice being now established of rolling and forging parts at a minimum temperature to insure high elastic limits and maximum tenacity.

R. H. THURSTON.

Experimental Psychology. A Manual for Laboratory Practice. By EDWARD BRADFORD TITCHENER. Volume I. Qualitative Experiments; Part I. Student's Manual. Pp. 214. Part II. Instructor's Manual. Pp. 456. New York, The Macmillan Co. 1901.

The place of laboratory practice in the teaching of psychology has, in American universities at least, become assured. It is by no means

* *Trans. A. S. C. E.*, 1873. 'Materials of Engineering,' Vol. II., Chap. X.; Vol. III., Chaps. XIII., XIV.—R. H. T.

settled in method, mode of instruction, arrangement of the work, or indeed of the principal aims to be accomplished. There has been too little time for any usage to become traditional or classic; and individual solutions of the important as well as of the incidental problems have been the unavoidable rule. Such usage is likely to become established through the influence of laboratory manuals more easily than through any other source. Sanford's manual is the pioneer in this field, and has been available in various stages of incompleteness for five years or more. Cattell maintained an attractive announcement in a publisher's list for some years; but this was withdrawn on the publication of Sanford's book. Scripture has published some helpful notes on the conduct of experimentation in the psychological laboratory; Höfler and Witasek have recently published a book of *Schulversuche*; and other sporadic contributions to special parts of this topic may be found by the industrious seeker. Professor Titchener's volumes form a weighty addition to this small group of pedagogical aids, and one certain at once to take high rank and to have an important part in the shaping of experimental usage in psychology.

The plan of the work covers two volumes; the first devoted to qualitative experiments, the second to quantitative experiments. These, again, will appear in two forms; the one for the students and the other for the use of the teacher. The present two volumes include the qualitative experiments for the student and for the instructor. It is, therefore, as yet premature to judge of the scope of the completed work; but the architectural principles upon which it is reared are sufficiently represented in this first portion to enable one to intelligently estimate the place which the whole is to occupy in the literature of psychology. The student's manual proceeds, after a brief introduction on the general arrangement of experimentation, to consider sensation (six chapters, including the five senses and organic sensation), the affective qualities, attention and action. Then follows a consideration of the rôle of perception, and the association of ideas—falling into chapters on visual space perception, auditory perception, tactual space perception, ideational

type and the association of ideas. This range of matter is grouped in thirty-seven experiments, many of them rather complex in character and involving a considerable number of separate observations. The experiments are clearly and suggestively elaborated, the instructions lucid, the emphasis laid on the interpretation of the results commendable. There are numerous illustrations, and the mechanical features of the volume leave nothing to be desired. The work represents the result of many years of experience of an experimental psychologist who emphasizes, as markedly as any of his colleagues, the importance of laboratory practice, and has evolved for his own use as comprehensive a system as is in vogue in any laboratory of psychology. The scholarly character of the result, the authoritativeness of the positions therein embodied, are unmistakable. Every director of a laboratory of psychology, small or large, will find much direct aid and more indirect suggestion in this newest manual.

The central question, upon which there is likely to be a marked difference of opinion, relates to the plan of the work and its adaptability to the several needs and facilities of the university and college courses in psychology. The division of the work into a qualitative and a quantitative part is evidently fundamental in the author's conception. Sanford's manual combines the two in a serial treatment of topics. How the two camps will divide it is not easy to foresee; for though we may hold that pedagogy is a science, it does not give unambiguous answers to such queries. The analogy to chemistry is at once suggested. But in chemistry there is in the main only a repetition of the one analysis with added mathematical factors; this seems hardly the case in psychology. The separation of the two in chemistry introduces no sense of incompleteness; and for introductory instruction, the one has a traditional and well-founded prestige. Neither fact is true of psychology. The practical question of economy of time and advantage in going over the ground once qualitatively and again quantitatively will deter many from introducing this practice even if they favor it upon logical grounds.

The present writer, after weighing the pros and cons both of a theoretical and of a practical

sort, must decide for his own part in favor of a topical treatment in which qualitative and quantitative analyses are conjointly used and regarded as methodical aids to the elucidation of principles and the determination of results. As in physiology we consider first the bony system, then the circulatory, then the nervous system, and so on and in the end and all the way through keep in mind the mutual interrelations of these systems, and introduce quantitative determinations so far as they aid the comprehension of the functions considered; so in psychology there is good ground for considering that the greatest pedagogical success and the clearest insight into the significance of mental phenomena will be reached by the pursuance of a similar method of exposition. For those of this opinion, it will still be possible to use the qualitative and quantitative parts together, though with some readjustment of method. Another marked characteristic of the manual is the selection of a relatively few groups of experiments and the careful elaboration of these. In this an exemplar may be found in the usage of many laboratories of physics. In the unsettled status of psychological practice this point is also likely to be favored by some and rejected by others. The principle involved is this: How far shall an experiment represent a verification by each individual of the essential facts of a given principle or trait of mental processes? or shall it be a miniature reestablishment of the method and the evidence which led to the formulation of that principle? Sanford adopts the former plan, Titchener the latter. Again, both practical and theoretical considerations will affect one's decision; that the former practice is the more readily assimilated to the ordinary practice courses of our universities admits of little doubt. These, then, are some of the differences of route which the psychological tourist will encounter; and he must choose his own guide and take the benefits and losses that result from his choice. Which is the easier road to travel, which affords the better outlook, experience alone will decide. It is fortunate that our psychological guides, in this case, are animated by the best of motives and equipped with admirable training for their tasks.

Both Sanford's and Titchener's manuals are adapted to the student with a marked and well-grounded interest in the work. They are manuals for 'long course' specialized students. There is still an urgent need for a more elementary manual that will cover a small number of carefully selected experiments in a way suited to the 'short course' students. Such seems to have been promised by the announcement which Cattell withdrew, and is in a measure accomplished by the German manual above referred to, and may be approximated by a judicious selection and reconstruction of Sanford's experiments. While welcoming a new and important aid to the teaching of experimental psychology, this need, that is still to be satisfied, may be appropriately noted.

The instructor's manual is a complete innovation in the literature of psychology, and one to be highly valued. It is to be understood that this is an entirely different book from the other, though necessarily following the same order of experiments and the same unfoldment of topics. Yet the text is addressed to the director of the experiments; he is given a complete account of the sources of error, and the precautions to be followed in the conduct of the experiment, is referred to the appropriate literature, and to more exact apparatus and observations not suited to student use. This, indeed, is in many ways the most valuable portion of the work. It makes possible for the first time the systematic training of the assistant by the director of the laboratory, and gives the special student in experimental psychology a reliable and methodical guide to the problems with which he is in the main to be concerned. The use of this manual as a basis of a special course for advanced students, in training to become professional psychologists, is one of its possibilities apart from its primary function. Professor Titchener has here placed at the disposal of his colleagues the result of years of very special and successful devotion to the problems of psychology susceptible to treatment by the experimental methods, and for this service so admirably accomplished he is entitled to the honors and privileges attaining to the distinction of carrying through so difficult and important a piece of pioneer work.

It is in the instructor's manual, likewise, that the spirit of the author's laboratory methods comes more clearly to the foreground. The presentation is more intimate, the descriptions more comprehensive, and the insight into the training which the course is intended to give more manifest. The genial set of instructions headed 'How to Fail in Laboratory Work,' might serve a good purpose if prominently exhibited in the laboratory. But the main point to be noted is the thorough appreciation of the fact that the psychological experiment carries with it its own conditions and peculiarities; that in becoming a 'subject' the individual retains all his peculiarities; and that these must be dealt with by tact and resource. The difference between good and bad observation upon mental matters depends upon this, almost equally with the acquaintance with method and technique. Both for the method and the matter, these volumes and the two to follow must be valued as amongst the most important of recent contributions to the furtherance of the aims of experimental psychology.

JOSEPH JASTROW.

Peach Leaf Curl: Its Nature and Treatment. By NEWTON B. PIERCE, in charge Pacific Coast Laboratory, Santa Anna, California. Bulletin No. 20, Division of Vegetable Physiology and Pathology, U. S. Department of Agriculture. Washington, Government Printing Office. 1900. Pages 1-204; plates I.-XXX.

A carefully detailed and exhaustive account of the geographical distribution, history, horticulture, botany and pathology of this destructive disease, and of experiments with the various remedies, methods and appliances for treating it. The most important of the conclusions is that very large percentages of the injuries due to the parasitic fungus *Exoascus deformans* are not caused by the renewed growth of perennial mycelium, but are the result of new infections occurring in early spring, and thus preventable by spraying the still unopened buds with Bordeaux mixture or other fungicides. Previous failures with such treatments are explained by the fact that the remedy was applied after the pathogenic organism had hidden itself in the tissues of its host.

As the annual losses from leaf curl in the United States are estimated at \$3,000,000, the determination of these simple points is of great economic importance, and also of the widest interest, since this disease, unlike the yellows, extends to all regions where the peach is cultivated.

BOOKS RECEIVED.

Select Methods of Food Analysis. HENRY LEFFMANN and WILLIAM BEAM. Philadelphia, P. Blakiston's Son & Co. 1901. Pp. viii + 383. \$2.50.

L'évolution du pigment. G. BOHN. Paris, G. Carré and C. Naud. 1901. Pp. 96. 2 fr.

Towers and Tanks for Water Works. J. N. HAZLEHURST. New York, John Wiley & Sons; London, Chapman & Hall. 1901. Pp. ix + 126.

SOCIETIES AND ACADEMIES.

AMERICAN MATHEMATICAL SOCIETY.

A REGULAR meeting of the American Mathematical Society was held at Columbia University, New York City, on Saturday, April 27, 1901. About thirty-five persons attended the two sessions. Vice-President Thomas S. Fiske occupied the chair. The following persons were elected to membership: Mr. C. W. McG. Black, Yale University; Dr. S. E. Slocum, University of Cincinnati. Two applications for membership were received.

To relieve the increasing burden of administration, the office of Assistant Secretary was created and filled by the appointment of Dr. Edward Kasner, to serve until February, 1902.

The library of the Society, which at present consists mainly of some five hundred unbound volumes of journals received as exchanges, is about to be deposited in the library of Columbia University, under an agreement by which the University undertakes to bind, catalogue and care for the books now on hand and all future additions, and to make them easily accessible to the members of the Society. Arrangements will be made by which the books may be temporarily loaned to members living at a distance. The library is to be kept as a separate collection, duplicating as far as may be the general University library, and aiming to become as complete as possible in itself. The title to the books remains in the Society, which reserves